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ABSTRACT

Presented is a summary of an Educational Testing Service (ETS) review of mean scores on the Graduate Record Examination (GRE) of candidates for graduate study in science and engineering fields for the period 1970-1975. Test results were found to have remained essentially stable over the period within each particular field. Significant differences between fields were found, with science and engineering candidates averaging more than one standard deviation higher than non-science fields in quantitative ability. No difference in verbal ability occurred on the average between science and non-science groups; however, within the science fields, engineering candidates averaged noticeably lower than the others. Education candidates averaged lowest of all groups in both verbal and quantitative mean scores. (SL)

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nsf SCIENCE RESOURCES STUDIES HIGHLIGHTS

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Aptitude Test Scores of Prospective Graduate Students in Science Remained Essentially the Same from 1970 to 1975

- A recently completed NSF-sponsored study, addressing the issue of whether in recent years there has been a decline in the quality of candidates for graduate study, has found that over the period 1970-75 there were no changes of practical significance in aptitude-test mean scores among prospective graduate students in science and engineering (S/E) fields.
- Within each of the major broad S/E fields, the mean scores of candidates on the verbal and quantitative aptitude test of the Graduate Record Examination (GRE) were found to have remained essentially stable over the observed period. Thus, insofar as the abilities measured by these tests are concerned, there have been no declines of significance in the quality of applicants for science graduate study.
- The major differences in verbal and quantitative aptitude observed in the study were those between students in different fields, and these differences occurred consistently over the whole period. In quantitative ability, candidates for admission to graduate study in S/E fields averaged more than one standard deviation higher than candidates in nonscience fields, and within S/E fields, examinees in engineering and the mathematical and physical sciences averaged nearly one standard deviation higher than those in the life and basic social sciences. In verbal ability, the science and nonscience candidates did not differ on the average, but within the science group, engineering candidates averaged noticeably lower than the others. The study was carried out by the Educational Testing Service (ETS).

Recent Influencing Developments

The recent past has witnessed a number of developments that might be expected to influence negatively the career choices of students who have the potential to be scientists and/or engineers. Among these developments are projections of an imbalance between the supply and the utilization of doctorates in S/E fields and an increased interest in fields such as business, law, and medicine. Some very able students, motivated primarily by nonpecuniary factors, may be expected to pursue careers in science and engineering without regard to employment possibilities. Others, equally able, may, on the other hand, respond to what they perceive as unfavorable prospects for employment or for the attainment of desired levels of income in S/E professions. In this context it becomes of interest to examine the possibility of significant changes in recent years in the ability patterns of students entering graduate study in S/E fields.

There is, however, no readily available source of information on the tested abilities of persons actually admitted to graduate study in S/E fields. Therefore, this study focused on possible changes in the abilities of applicants for admission to graduate study in these fields, using information from the historical file of scores on the Graduate Record Examination (GRE). Since the scholastic aptitude tests of the GRE are the same for all applicants regardless of the field of intended graduate study, these files can also supply information on trends over recent years in the abilities of applicants for admission to graduate study in nonscience fields, which can be compared to those of science-field applicants in the same period.

Aspects of the GRE

The GRE consists (1) of scholastic aptitude tests that yield a verbal and a quantitative score; and (2) of subject-matter tests in 19 different subject-matter areas. A high proportion of examinees take only the aptitude tests, since many American graduate schools require only those and not the subject-matter tests. For the purposes of the ETS study under discussion here, only aptitude-test scores were used, since subject-matter test scores were not available for many applicants in a field over the years in question, and since one of the main purposes of this study was a comparison of trends in the aptitudes of S/E applicants with those of applicants for admission to graduate study in nonscience fields.

(Prepared in the Science Education Studies Group, Division of Science Resources Studies)

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Trends in Graduate Record Examination test scores: 1970-71 to 1974-75

[Number of cases, mean scores, and standard deviations for verbal and quantitative aptitude tests by prospective field of graduate study and by year]

Prospective field of graduate study	Aptitude	1970-71			1971-72			1972-73			1973-74			1974-75			All years		
		Number	Mean	S.D.	Number	Mean	S.D.	Number	Mean	S.D.	Number	Mean	S.D.	Number	Mean	S.D.	Total no.	Mean	S.D.[1]
Science																			
Physical sciences	V	499	512	136	323	500	134	474	519	130	454	502	126	526	508	133	2,276	509	130
	Q		650	106		643	109		648	105		648	113		630	110		644	106
Mathematical sciences	V	415	517	141	248	495	135	362	510	131	404	513	139	384	506	126	1,813	509	136
	Q		675	104		673	91		676	96		675	97		661	104		672	99
Engineering	V	665	444	132	372	448	122	544	455	132	573	449	133	594	440	127	2,748	447	129
	Q		656	98		651	97		665	93		663	100		649	103		657	99
Life sciences	V	1,036	491	122	716	491	122	1,069	504	117	1,202	508	121	1,347	509	116	5,370	502	119
	Q		556	120		553	122		570	118		569	117		568	118		564	120
Basic social sciences	V	2,085	533	117	1,570	527	116	2,176	522	120	2,153	525	119	2,185	521	120	10,169	525	121
	Q		530	118		526	120		521	125		521	127		518	128		523	124
Nonscience																			
Health professions	V	358	500	114	256	502	108	376	509	107	471	508	113	597	502	103	2,058	504	110
	Q		496	119		501	117		508	120		507	120		513	119		506	120
Education	V	2,993	472	110	2,120	463	112	2,988	452	113	2,953	449	113	2,745	454	113	13,799	458	112
	Q		462	120		457	119		450	119		442	120		445	120		451	120
Arts and humanities	V	2,686	548	118	1,659	534	117	2,571	537	120	2,574	541	125	2,405	542	121	11,895	540	123
	Q		494	118		492	116		493	122		494	121		490	120		493	118
Applied social sciences	V	983	492	113	694	482	111	1,038	484	121	1,180	493	121	1,270	488	118	5,165	488	119
	Q		480	121		475	123		475	126		477	122		464	123		474	122
Other nonsciences	V	880	496	124	580	490	124	961	501	125	917	498	124	901	496	125	4,239	497	123
	Q		498	123		500	119		502	121		495	128		498	126		499	122

[1] Calculated by NSF, using formula $S.D.(X) = \sqrt{\frac{\sum_i [n_i \bar{x}_i^2 + (n_i - 1) s_i^2(x)] - N\bar{X}^2}{N-1}}$

where S.D.(X) = the standard deviation of the scores in a given field in a given test for the entire 5-year period; n_i = the number in the field in the ith year of the period; $\bar{x}_i$ = the mean score in the test of those in the field in the ith year; $s_i(x)$ = the standard deviation of the test scores of those in the field in the ith year; N = the total number in the field over the 5-year period; and $\bar{X}$ = the mean score of the entire group (N) in the test.

Note: V=Verbal, Q=Quantitative, and S.D.=Standard Deviation.
Sources: Educational Testing Service and National Science Foundation.

Field Classification of Students

The study was based on a one-to-fifteen sampling of those cases in the GRE historical file for the period under examination for which data necessary to the study were available. The students were classified according to the field of the department to which their GRE scores were to be sent rather than by their undergraduate majors. Departments or subfields of intended study were grouped in accordance with a broad-field break of 10 fields—five science and five nonscience. The five major fields into which S/E candidates were classified were engineering and the physical, mathematical, life, and basic social sciences.[1]

Scores on GRE Aptitude Tests

The accompanying table displays, by field and year, the mean scores in the verbal and quantitative aptitude tests found among the sample of graduate-student applicants in the 10 broad fields into which students were classified for the purpose of this investigation. Also displayed for each field are the number of cases in the sample and the standard deviations of the two test scores in each year. The last columns of the table show the mean test scores and standard deviations for all of the sample candidates in each field over the entire 5-year period.

Some weak trends within fields could be observed over the period. In the life sciences, verbal mean scores tended to increase slightly, while those in the basic social sciences tended to decrease.

Chart 1 displays, for each of the 10 broad fields of study for the entire 5-year period, the mean scores in both verbal and quantitative aptitude, the verbal score on the vertical axis and the quantitative on the horizontal. (These are the mean scores that appear in the last column of the accompanying table.)

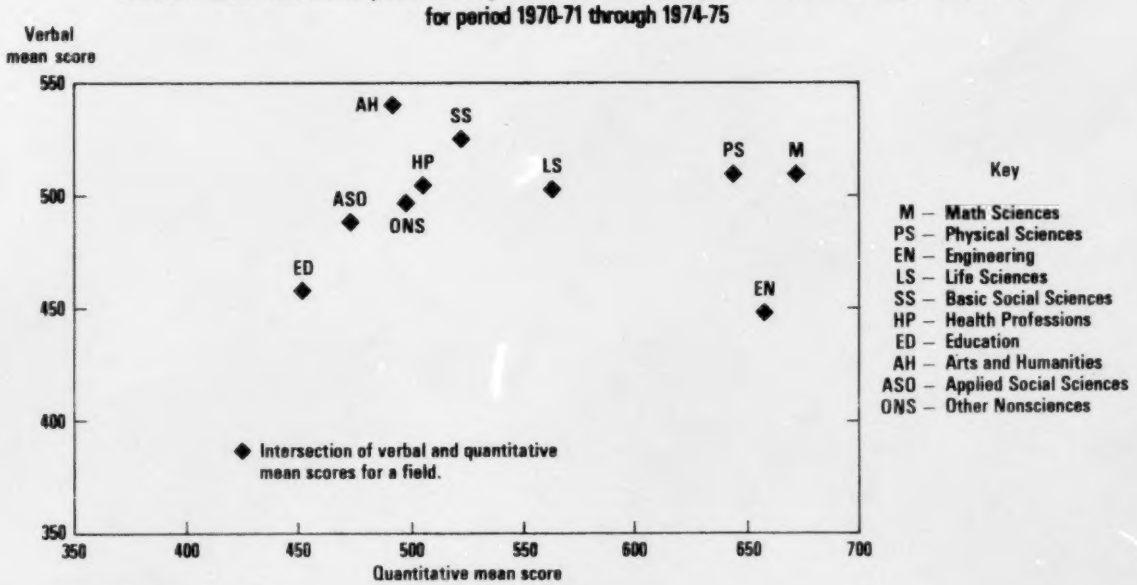
Comparisons of the Science Groups

Chart 2 displays the points shown in chart 1 for the five science fields and also illustrates, in the form of five rectangles, the areas within which the scores of the middle 50 percent of the examinees in each S/E field fell over the 5-year period. Chart 2 shows that in quantitative aptitude there is a greater degree of homogeneity and less variation within engineering and the mathematical and physical sciences groups than there is within the life and social sciences groups. In verbal aptitude, on the other hand, there is more variation within the mathematical and physical sciences and engineering groups than there is within the life and social sciences groups. As for similarities between candidates in different fields, the two groups that have the greatest overlap are the physical and mathematical scientists, with their verbal means identical and their verbal interquartile ranges (25th to 75th percentile) highly similar. In their quantitative means and interquartile ranges, they are likewise fairly close to each other.[2]

[1] The full report of this study contains a detailed list of the subfields which are included within each of the 10 broad field categories. (For information on obtaining a copy of the full report, see the last page of this *Highlights*.)

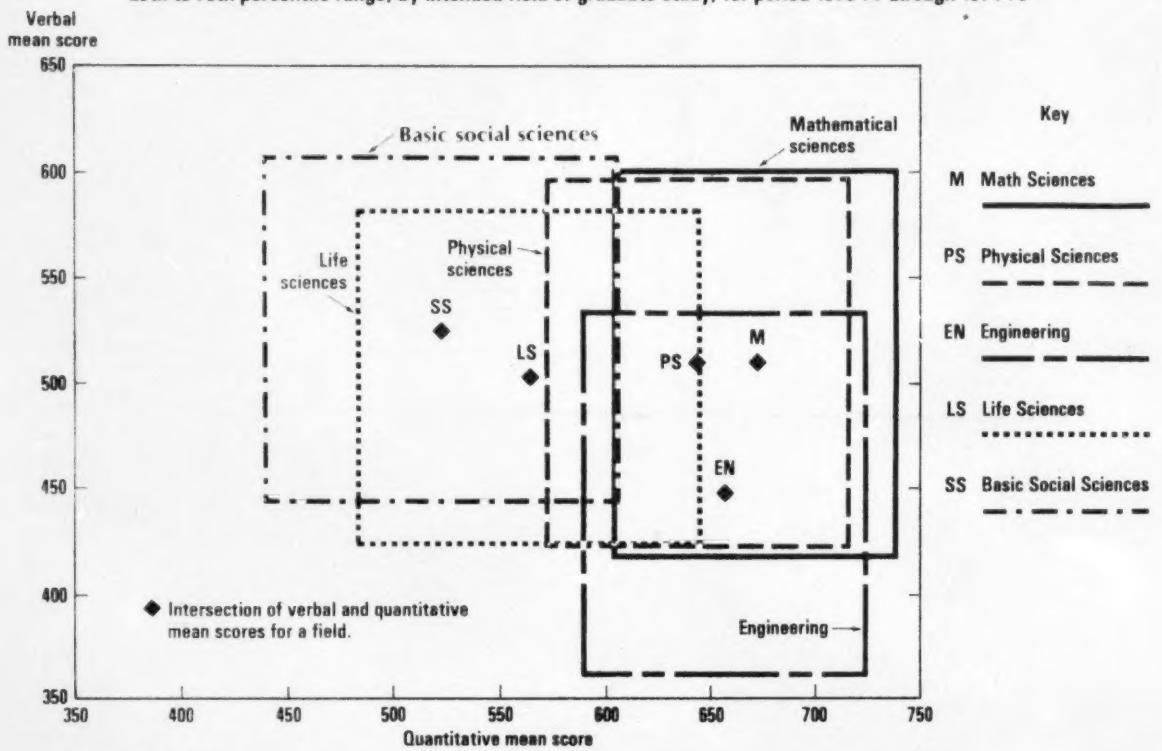
[2] The determination of the interquartile ranges of the scores in the several fields here was based on the assumption that the distribution of scores within each field was normal; accordingly, ± .675 of the standard deviation was the value used to calculate the magnitude of this range.

CHART 1. GRE[a] verbal and quantitative aptitude-test mean scores, by intended field of graduate study, for period 1970-71 through 1974-75



[a]Graduate Record Examination
SOURCE: Educational Testing Service and National Science Foundation

CHART 2. Science/engineering applicant GRE[a] verbal and quantitative aptitude-test scores: mean scores and 25th to 75th percentile range, by intended field of graduate study, for period 1970-71 through 1974-75



[a]Graduate Record Examination
SOURCE: Educational Testing Service and National Science Foundation

The full report of this study contains, in addition to the list of subfields referred to above, coefficients of correlation and analyses of variance of the scores on the verbal and quantitative aptitude tests, by field and year, and technical notes on such aspects of the study as the sampling plan used, the comparability of GRE tests from year to year, etc. Single copies of the full report, *Trends in Aptitudes of Graduate Students in Science* by Robert F. Boldt of the Educational Testing Service, are obtainable from the Division of Science Resources Studies, National Science Foundation, Washington, D.C. 20550.

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